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DEPARTMENT OF STATE LANDS

TED SCHWINDEN GOVERNOR

CAPITOL STATION

STATE OF MONTANA

(406) 449-2074
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1625 ELEVENTH AVENUE
HELENA, MONTANA 59620

December 10, 1981

Chris Cull
Western Energy Company
113 North Broadway
Billings, Montana 59101

Re: Alluvial Valley Floor Decision Document

Dear Chris;

Attached is a copy of the Department's alluvial valley floor (AVF) determination for the portion of East Fork Armells Creek (EFAC) between the western extent of Western Energy Company's Area C and Highway 39 near the town of Colstrip, Montana.

This document was prepared by DSL staff based on:

1. Five years of infrared photography
2. Literature review
3. On-site investigations by DSL staff
4. Field data submitted by Hydrometrics for Western Energy Company
5. Personal communication with Mr. Leo Farley

It is the decision of this document that an AVF, as described by Montana's Strip and Underground Mine Reclamation Rules and Regulations [26.4.325(2)(b)(i & ii) does not exist along the portion of East Fork Armells Creek described above. AVF decisions will have to be made for EFAC should mining be planned west of the Area C boundary. Also, the Department is initiating AVF studies for Stocker Creek and the portion of EFAC below the eastern boundary described in this document. Department staff will be contacting your office about these investigations.

Sincerely,

Brace Hayden, Administrator
Reclamation Division

c: Hydrometrics
    Commissioner Moon
    Gary Amestoy

GL:lw

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ALLUVIAL VALLEY DECISION DOCUMENT
For A Portion of East Fork Armells Creek in the Vicinity of Western Energy's Rosebud Mine

prepared by the Montana Department of State Lands, Reclamation Division

12/10/81

The Armells Creek watershed includes approximately 370 square miles; 42% (155 square miles) of which lies within the East Fork Basin. The climate is continental steppe typical of the Northern Great Plains, averaging approximately 15.5" of precipitation annually The terrain is generally flat to gently rolling with occasional escarpments. The area is underlain by the Tongue River Member of the Fort Union Formation which consists of sandstones, siltstones, claystones and the Rosebud and McKay coal seams.

The portion of the East Fork Armells Creek Basin considered in this decision document lies between the western extent of Western Energy Company's (WECO) proposed Area C mining activity and Highway 39 at Colstrip, Montana where the creek turns to the north. Ownership along East Fork Armells Creek (EFAC) is as follows:

TABLE 1

Section	Surface ownership	Mineral ownership
T1N, R40E		
1	BN - leased Farley & Broadus****	BN
7	BN - leased Farley*	BN
8	Farley (SUA WECO)**	Federal
9	BN*** - leased Farley	BN
10	Farley (SUA WECO)	Federal
11	BN - leased Farley	BN
12	Farley (SUA WECO)	Federal
14	Farley (SUA WECO)	Federal
15	BN - leased Farley	BN
16	State	State
17	Farley	BN
18	Farley	Federal
T1N, R41E		
3	BN - leased WECO	BN
4	WECO	Federal
5	BN - leased WECO	BN
7	BN - leased Farley	BN
T2N, R41E		
27	MT Power - WECO	BN
28	MT Power - WECO	Federal
33	Sunlight Development	BN
34	MT Power	Federal

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* Mr. Leo Farley
Farley Hereford Ranch
Huntley, MT 59037

** (SUA - WECO) - surface use agreement
*** Burlington Northern
**** Mr. Hugh Broadus
Route 1
Forsyth, MT 59327

Source: Sherry Schwend, Western Energy (Pers. Comm.)

The Department of State Lands (DSL) has determined that EFAC, in the area described previously, does not meet the requirements of an alluvial valley floor as described in Montana's Strip and Underground Mine Reclamation Rules and Regulations 26.4.325(2)(b)(i) & (ii). The Rules and Regulations state that the Department shall determine that an AVF exists if it finds that:

1. Unconsolidated streamlaid deposits holding streams are present; and
2. there is sufficient water to support agricultural activities as evidenced by:
    A. the existence of flood irrigation in the area in question or its historical use;
    B. the capability of an area to be flood irrigated, based on stream-flow water yield, soils, water quality, and topography; or
    C. subirrigation of the lands in question derived from the groundwater system of the valley floor.

DSL's findings regarding each of these criteria are further explained below.

The Department has made its' decision based on:

1. Literature review
2. Personal communication with Mr. Leo Farley
3. On-site inspection
4. Field data submitted by Hydrometrics for WECO.
5. Five years of infrared aerial photo coverage

1. Unconsolidated Streamlaid Deposits

The extent of alluvial, or unconsolidated streamlaid deposits in EFAC was identified by Hydrometrics for WECO based on geomorphic criteria and drill hole data. Geomorphic mapping of the alluvial valley was accomplished using color infrared aerial photographs and field reconnaisance, with two alluvial cross sections as supporting data.

The general stratigraphy of alluvial materials is that of fifteen to twenty feet of fine-grained colluvial, aeolian and alluvial materials over one to fifteen feet of sandy gravel (Hydrometrics, Volume III). The outer boundary of the alluvium is not precise, as drill log data is sparse and it is difficult to distinguish fine-grained alluvium from fine grained colluvium. In light of the Department's decision as to the absence of an AVF on EFAC, a more precise outer alluvium boundary was deemed unnecessary.

EFAC meets the first criteria of an AVF in that it contains unconsolidated streamlaid deposits. However, the Department has determined that EFAC does not meet the second criteria of having sufficient water to support agricultural activities in 26.4.325(2)(b)(ii). This decision is discussed in the following sections.

2. Sufficient Water to Support Agricultural Activities

As indicated earlier there are 3 criteria used to determine whether there is sufficient water to support agricultural activities on an alluvial valley floor. The remainder of this document is a point-by-point discussion of those criteria.

A. The existence of flood irrigation in the area in question or its historical use.

Flood irrigation means, with respect to alluvial valley floors, supplying water to plants by natural overflow or the diversion of flows, so that the irrigated surface is largely covered by a sheet of water. DSL believes that fields along EFAC are neither supplied water by natural overflows nor receive diversion of flows, so that the irrigated surface is largely covered by a sheet of water.

The basis for this information is:

1. Review of 5 years of aerial photos
2. Permit application data
3. USGS water-resources investigations
4. Operator, BN, and county assessor production figure
5. County statistics for 78-79

Present flood irrigation structures in the EFAC region were developed in the 1920's. General practice in the region has shown that many of the irrigation structures constructed prior to 1940 have not proved to be efficient and have been abandoned. No recent construction of flood irrigation systems in the Armells Creek drainage are known to have occurred (WECO). The USGS (1981, Ferreira, R. F.) estimates that there are no irrigated acres in the 155 square miles of the EFAC basin.

Although a ditch-dam irrigation system is present in the portion of EFAC described above, DSL believes the system has not increased agricultural production.

The following is the basis for DSL's decision.

A review of 5 years of aerial photos was made by DSL staff. The photos for the years covering 1973-76 were taken at the end of June or early July. Red or pink on infrared photos is a measure of evapotranspiration, the more red, the more water in the system. An active flood irrigation system should be very red during the part of the year examined. The EFAC photos were very similar in nature to the native range or upland vegetation in the area. DSL staff concluded that fields along EFAC were dryland in nature based on the lack of red and pink hues in the photo coverage. To support this conclusion DSL reviewed the production figures of the operator, BN, and the county assessor presented in Table 2.

TABLE 2

EAST FORK ARMELLS CREEK

Field #	Crop	Acres	Landowner(1)	BN(2)	County Assessor(3)
1	Winter wheat	28	35 bu/ac**	no data	24-25 bu/ac
2	Crested wheatgrass/ alfalfa	35	1.0 t/ac**	no data	.5-.9
3	Crested wheatgrass/ alfalfa	45	1.0 t/ac**	no data	.5-.9
4	Crested wheatgrass/ alfalfa	50	1.0 t/ac**	no data	.5-.9
5	Crested wheatgrass	43	1.0 t/ac**	grazed after 1963	none
6	Crested wheatgrass/ alfalfa	50	1.0 t/ac**	grazed	none reported
7	Crested wheatgrass alfalfa	40	1.0 t/ac**	no data	none reported
8	Crested wheatgrass/ alfalfa	37	1.0 t/ac**	no data	none reported
9	Wheat	130	27 bu/ac*	no data	no data
10	Crested wheatgrass/ alfalfa	36	0.6 t/ac*	no data	no data
11	Crested wheatgrass	31	0.6 t/ac*	no data	no data
12	Crested wheatgrass	17	0.6 t/ac*	no data	no data
13	Wheat	125	27 bu/ac*	22.1 bu/ac	22-23 bu/ac
14	Alfalfa	68	2.0 t/ac*	no data	1.5-1.9 t/ac
15	Crested wheatgrass/ alfalfa	91	0.6 t/ac*	0.84 t/ac	1.5-1.9 t/ac
16	Winter wheat	53	27 bu/ac*	22.1 bu/ac	22-23 bu/ac

Source:

(1) Based on Landowner interviews conducted in September 1980 and 1981.
(2) Burlington Northern; 1971-1980. Unpublished data.
(3) Rosebud County, 1978. Rosebud County assessed sectional agricultural production. Unpublished data.

** Production data specific to the field as reported by Leo Farley in September 1981.

* Average production for the entire ranch as reported by landowners in September 1980.

DSL also reviewed average production statistics for Rosebud County from 1978 and 1979 (Table 3).

TABLE 3

Wheat and hay yields (bushels/acre and tons/acre) for Rosebud County - 1978 and 1979

		1978	1979	2 year average
Winter wheat	irrigated	47.0 bu/ac	40.0	43.5
	not irrigated	30.0	27.8	28.9
Spring wheat	irrigated	40.0	40.0	40.0
	not irrigated	28.0	12.0	20.0
Alfalfa hay	irrigated	3.20 t/ac	3.63	3.42
	dryland	1.56	1.18	1.37
All hay	irrigated	2.90	3.18	3.04
	dryland	1.45	1.02	1.24

Source: Montana Department of Agriculture, 1980. Montana agricultural statistics: County statistics 1978 and 1979, Volume 18.

Field 1 and field 14 were the only fields to show production above dryland yields. Field 14 is discussed in a later section of this document. Field 1 production is apparently a reflection of the excellent conditions for winter wheat in 1981. However, field 1 is not pertinent to this determination because no flood irrigation ditch services the field and no potential for subirrigation exists in that field.

Therefore, because of the agreement among all criteria reviewed, DSL believes that flood irrigation is not actively conducted along EFAC.

B. The capability of an area to be flood irrigated based on stream-flow water yield, soils, water quality and topography.

DSL believes that the ditch and dam system on the ground at EFAC is the logical expression of the capability of the area to be flood irrigated. There appears to be no gross management errors in the farming operation. Simply, water availability is a limiting factor, and production is on a dryland basis.

C. Subirrigation of the lands in question, derived from the groundwater system of the valley floor.

Subirrigation means, with respect to alluvial valley floors, the supplying of water to plants from underneath or from a semi-saturated or saturated zone where water is available for use by vegetation. The Montana Strip and Underground Mine Reclamation Rules and Regulations state that diurnal fluctuation, soil moisture desorption curves, mottling, and streamflow measurements shortly after killing frosts are the tools used to measure subirrigation. However, based on past AVF determinations the Department believes these tools to be inconclusive because of the complexity of such measurements and the lack of control when outside of laboratory conditions. In place of these tools DSL has developed tests ~~that it believes are more accurate~~ for determining subirrigation. Those tests are: the following

1. Review of infrared aerial photography.
2. Determination of a usable capillary fringe based on Bauder et al 1978.
3. Depth to groundwater.

When a combination of groundwater and capillary fringe bring water to within 14.5' of the surface, agricultural crop enhancement may be expected. In addition, when vegetation is actively photosynthesizing, it will appear red on an infrared photograph.

A review of the lithologic logs of wells drilled along EFAC revealed a preponderance of coarser sediments. The relative amounts of coarse versus fine-grained sediments were calculated by summing the various textural classes to a depth of 20' of all wells for which lithologic logs were available. While additional well data would more accurately define the alluvial system, the Department believes the number of wells present provide sufficient data to make a decision. Sand and gravel, silty sand, sand and silty gravel are coarser materials and make up 53% of the upper 20' of alluvium. These materials would support a smaller capillary fringe than finer-textured materials. Finer textural classifications include sandy loam, sandy clay, sandy silt, silt, silt loam, silty clay and clay. These textures comprise about 47% of the alluvial column to a depth of 20'.

In view of these considerations, an average 2.5' capillary fringe was assumed to exist along EFAC and a 17 foot depth to water table was considered maximum for subirrigation. In other words 17' (water table) - 2.5' (effective capillary fringe) = 14.5 (depth to usable subirrigation).

In addition to water table and capillary fringe considerations, 5 years of infrared aerial photographs were examined. These included 4 years taken at the end of June or the beginning of July (1973-76) and a 5th year taken 2 October 1980. The photographs indicated that virtually all the photosynthetic activity, and hence subirrigation, was confined to the narrow incised portion of EFAC channel, its tributaries, and some of the lower terraces.

There is excellent agreement between the water level data and the infrared photographic data. A comparison of the maps of agricultural activities along EFAC, delineation of subirrigation, and USGS data indicate there are no hayfields, improved pasture, or grain fields affected by subirrigation. The land identified as subirrigated is considered undeveloped rangeland since it is not managed or controlled and is considered of limited agricultural use.

Mr [illegible]
[illegible] ?

Therefore, because of the lack of agriculturally important subirrigation evidenced by this review, DSL does not believe EFAC meets the subirrigation requirements to consider it an AVF.

A question of possible subirrigation of the alfalfa field within the rail loop Field 14 adjacent to EFAC had to be resolved since DSL at one time considered it to be subirrigated. DSL made that decision on the basis of a statement that appeared in the Supplement to Preliminary AVF Investigation of East Fork Armells Creek in the Vicinity of Western Energy Company's Rosebud Mine Colstrip, Montana prepared by Hydrometrics (1980b). In that document it is stated that "in backhoe pits 5 and 6 the static water level was below 15.0' (pit 5) and 15.3' (pit 6) from July to November..." DSL interpreted that to mean the water level was approximately 15.0' and 15.3' respectively. That is not the case. In fact, WA 139 (pit 6) and WA 140 (pit 5) show water levels to be at 18.0 and 16.5 feet respectively. The water table of 16.5' is a reflection of surface topography (a draw) and may be subirrigated during parts of the year. However, its size is areally restricted and the majority of water table depths within the loop indicate it is not subirrigated.

DSL believes the following factors explain the higher production of the railroad loop alfalfa field compared to the surrounding area: (1) the alfalfa field is relatively young, having been first planted in 1974; (2) the alluvial soils have excellent water holding capacity and there is evidence of a clayey layer at a depth of 4-5 feet throughout much of the field. The clayey layer reduces the amount of deep infiltration creating, in effect, a shallow perched water table; (3) the flat lying topography of the field and sandy loam texture of the surficial 4-5' allow for more complete infiltration of precipitation and reduce the amount lost to runoff; and (4) the alfalfa field has received above normal precipitation for 4 of its 7 years. DSL believes the above factors are responsible for the above average production rates obtained from the railroad loop field.

Thus, in conclusion, EFAC is not an AVF. Although EFAC meets the geologic criterion it fails to meet the agricultural criteria of an AVF.

REFERENCE PAGE

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